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STATISTICAL METHODS OF THE STUDY OF THE MECHANISMS OF THE RELIA--ETC(U)

APR 77 L P PAVLOVA, A F ROMANENKO

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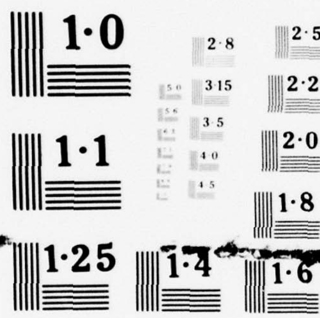
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STATISTICAL METHODS OF THE STUDY OF THE MECHANISMS OF THE RELIABILITY OF THE BRAIN OF MAN

by

L. P. Pavlova, A. F. Romanenko,
G. A. Sergeyev

FOREIGN TECHNOLOGY DIVISION

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В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
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З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
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Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere. When written as ё in Russian, transliterate as yё or ё. The use of diacritical marks is preferred, but such marks may be omitted when expediency dictates.

GREEK ALPHABET

Alpha	Α	α	α	Nu	Ν	ν	
Beta	Β	β		Xi	Ξ	ξ	
Gamma	Γ	γ		Omicron	Ο	ο	
Delta	Δ	δ		Pi	Π	π	
Epsilon	Ε	ε	ϵ	Rho	Ρ	ρ	ϱ
Zeta	Ζ	ζ		Sigma	Σ	σ	ς
Eta	Η	η		Tau	Τ	τ	
Theta	Θ	θ	ϑ	Upsilon	Τ	υ	
Iota	Ι	ι		Phi	Φ	φ	ϕ
Kappa	Κ	ϰ κ	ϰ	Chi	Χ	χ	
Lambda	Λ	λ		Psi	Ψ	ψ	
Mu	Μ	μ		Omega	Ω	ω	

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English
sin	sin
cos	cos
tg	tan
ctg	cot
sec	sec
cosec	csc
sh	sinh
ch	cosh
th	tanh
cth	coth
sch	sech
csch	csch
arc sin	$\sin^{-1}$
arc cos	$\cos^{-1}$
arc tg	$\tan^{-1}$
arc ctg	$\cot^{-1}$
arc sec	$\sec^{-1}$
arc cosec	$\csc^{-1}$
arc sh	$\sinh^{-1}$
arc ch	$\cosh^{-1}$
arc th	$\tanh^{-1}$
arc cth	$\coth^{-1}$
arc sch	sech^{-1}
arc csch	csch^{-1}

Russian	English
rot	curl
lg	log

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STATISTICAL METHODS OF THE STUDY OF THE MECHANISMS OF THE RELIABILITY OF THE BRAIN OF MAN.

L. P. Pavlova, A. F. Romanenko, G. A. Sergeyev

Under the reliability of man we will understand his ability to the execution of the placed assignment during the specific time with the effectiveness, not less assigned.

The specific characteristics of reliability must be determined on the basis of strict differentiation of the specific forms of mental or physical activity, since this condition will determine the selection of adequate mathematical apparatus. If the problem of reliability and effectiveness of the physical forms of the work of man is solved by the methods of engineering psychology, then the specific character of mental work requires the knowledge of the

dynamic parameters of the brain, examine/considered in the form dynamic nonstationary system.

During the construction of the adequate informational model of brain as the basis is embedded the hypothesis about the determined or probabilistic character/nature of its reactions to input signals. The probabilistic model of brain widely used in the theory of perceptrons, but the degree of the constructiveness of these models proves to be the insufficient for the solution of the problem of operational monitoring reliability of the brain of man.

This leads to the need for its improvement by the attraction of the hypotheses, which simultaneously consider the determined and probabilistic character/nature of the informational model of brain. As adequate mathematical apparatus in this case can be utilized the theory of multidimensional unsteady random functions. In the present work we will pause at some results of the experimental study of the determined-probabilistic model of brain.

Properties of the informational model of brain. The model of brain in the form of multidimensional unsteady dynamic system must consider its separate discrete states, reflected by redistribution in the time/temporary and space coordinates of the local centers of the electric activity of brain. Judgment about the degree of the electric

activity of the determined section of brain can be obtained on the basis of electroencephalogram. In this case the degree of the spatial resolution of the relief of the generated by brain electric field with the aid of EEG turns out to be insufficient for the study of the reactions of separate neurons in view of the presence of the effect of integration subsequently it is assumed that the electroencephalogram reflects only the time/temporary properties of certain sufficient extensive group of neurons - neuron ensembles. By experimental studies established/installed,that to one level or the other of the work of brain in operator work are characteristic the determined combinations in the character/nature of the redistribution of the electric activity of the local-distributed centers of front/leading and posterior brain, and also the left and right of the hemispheres of the cerebral cortex of man (Pavlov, Sergey, 1964a, b). As the indicator, which considers the measure of the asymmetry between the symmetrical centers of the left and right hemispheres can be utilized the informational parameter which presents the ratio of the product of the sum of intervals of correlation by the dispersion of biopotentials of all removal/diversions of one hemisphere to the appropriate value of the product of the sum of intervals of correlation by the dispersion of the symmetrical removal/diversions of another hemisphere (Sergeys, etc., 1964).

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This indicator is sufficiently stable on the moderate phases of the mental fatigue of man.

The numerous facts, accumulated by contemporary physiology, confirm academician A. A. Ukhtomskiy's position (1950) about the fact that the basic operating unit of brain are the forming mobile/motile neuron ensembles or the constellations (constellation) of the nerve centers, which store/add up according to the principle of dominant.

The principle of dominant provides the unity of operation and the unidirectionalism of the operation of organism, and special importance it acquires in unlocking the mechanisms of the reliability of the brain of man.

The formation of the constellation of the nerve centers occur/flow/lasts over known laws - mastering working rhythm or synchronization in the activity of separate neurons because of increase, either a decrease in the level of the current activity, characterized in physiology by the parameter of lability or functional mobility. The phenomenon of mastering rhythm is the basis of the motor and mental skills of man (Vinogradov, 1958) it finds its expression in the frequency shifts of the biopotentials of brain;

therefore becomes important the autopsy of the informational structure of the process of excitation as a whole brain.

A whole series of facts confirms the representation of the stochastic principle of the organization of neuron ensembles (Rosenthal, 1961, Ashby, 1962; Kaufman a oth., 1963, etc.). The spontaneous electric activity of brain is characterized by the variable in time parameters, which reflects the process of the selective reaction of the sections of brain by stimulations (Kogan, Chorayan) and also the phenomenon of functional substitutions in costellations of the nerve centers (Pavlov, 1963). The last/latter phenomenon by us directly is joined with the mechanisms of the reliability of brain (Pavlov, Sergey, 1964a) on the basis of the principle of active rest, according to Sechenov (Pavlov, Sergey, 1964b).

It is shown, that the autopsy of the mechanisms of the work of brain is possible by the current statistical interpretation EEG under the condition of the time/temporary resolution of analyzed processes within the limits of the phase of the excited state of neuron ensembles. In this case mathematical model EEG is examined in the form of the sample of local-unsteady random process.

The mean time of the phase of the active mode of neuron ensemble

is 0.2 s. The requirement for the effectiveness of the statistical analysis of the biopotentials of brain in principle is attained only with the aid of the substances for electronics reckoning engineering.

Experimental studies revealed the presence in the brain of the mechanisms of integration, time/temporary selection, extrapolation and mechanism of memory, realized by means of the preservation/retention/maintaining of trace stimulations on the determined group of neuron ensembles.

By a series of the researchers (Rosenthal, 1961) is presented hypothesis about the fact that the role of the mechanism of time selection is reduced to the flow control oafferent momentum/impulse/pulses. By N. Weiner (1961) and by M. Brez'ye [1] (1962) is expressed hypothesis about existence in the structural formations of the brain of stable self-excited oscillators.

FOOTNOTE [1]. In recent works, the Russian transcription "Brezhe". - Editor's Note. ENDFOOTNOTE.

The preservation/retention/maintaining of the traces of irritation of the determined group of neuron ensembles is joined with the

time/temporary coding of the information, which enters from the receptor links through the time intervals, synchronized with the frequency of alpha-rhythm (8-12 Hz). It is experimentally established/installed that the frequency of the physiological rhythm, bonded with the extrapolating functions, is 15 Hz (Sergeys, other, 1964).

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The extrapolating functions of brain provide the appearance of the matched reactions of man to the determined form/species of external irritants. Control of the extrapolating functions occurs by the generation of the time-sequential routine of the electric signals, which stimulate the completely determined groups of the neuron ensembles, which realize coding of surgeries, characteristic to the determined dynamic stereotype of operation. If dynamic stereotype is considered as program of the formation of the sequence of the matched reactions to the determined form/species of irritant, then under the reliability of brain will be understood the probability of the activation of that group of the neuron ensembles whose excitation leads to adequate reaction to this type of irritant.

By the experiments of I. P. Pavlov's school it is shown, that the formed stereotype does not need the reproduction of an entire

sequence of signals, which correspond to the separate event/report of adaptable behavior. The complex sequence of reactions can be realized under the effect of stimulus of determinate structure, which performs the role of actuating signal (Asratyan, 1963).

The extrapolating functions of brain provide the high accuracy of control of motor components, since they make it possible to complete the missing information because of the utilization of the preceding experiment, coded in the structure of the stereotype of operation.

One of the important experimental results, obtained the methods of the theory of unsteady random functions, is the establishment of that fact that the coding of the extrapolating functions of brain conducts by changing the statistical parameters of biopotentials in frequency domain (Sergeys etc., 1965).

The study of the dynamic reactions of motor components during the execution of complex stereotype shows that the relative stability of the frequency parameters of biopotentials three times exceeds the stability of the time/temporary components. All these data indicate that with the mechanism of the spontaneous rhythmic activity of brain are bonded both the controlling and extrapolating functions. In the examination of the special feature/peculiarities of various

physiological rhythms is confirmed Simonov's assumption (1963) about the shielding function of the local electric activity - the alpha-rhythm, which ensures the protection of the frequency-selective higher analyzer centers of brain of the excitation by the fluctuating signals of weak subliminal irritants. This rhythm can also be examined as the modulating frequency, which ensures, in the first place, strengthening slow biopotentials by the method of modulation - demodulation and, in the second place, the synchronization of the flow of afferent momentum/impulse/pulses with a frequency of the admission of discrete information of from receptor links.

Reliability of brain during the execution of continuous operation is provided by the redundancy of the corresponding analyzer centers, by the paired hemispheres of brain (Pavlov, 1963), and also by the utilization of properties of the component structure EEG, which conditions the correlation between separate regions of the spectrum EEG. It is experimentally shown, that the effectiveness of operator's work significantly depends on the "focus" of electric activity in the left or right hemisphere, i.e., on the specific character of bilateral control of the functions of brain, and also of the relationship/ratios of the activity of front/leading and posterior brain (Pavlov, 1963; Sergeys etc., 1964).

Experimental investigations of the nonlinear characteristics of

brain. At present among the experimental methods of the theory of random functions in application to the tasks of the investigation of biopotentials greatest propagation received methods cross- and autocorrelation analysis.

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Cross-correlation analysis makes it possible to establish/install the degree of statistical communication/connection between the three-dimensional/space displaced sections of the electric activity of brain and thereby to obtain given on the topology of the excitable centers of the constellations, characteristic to the formed dynamic stereotype. The generalization of cross-correlation analysis to the multidimensional case composes the essence of the method of correlative pleiads, which recently is spread in electrophysiology.

Despite the fact ,that the data of cross-correlation analysis reveal a series of the qualitative laws governing the processes of the electric activity of brain, on the strength of a series of formal mathematical limitations they cannot be effectively used for the solution to the problem of the operational monitoring of the level of operator's effectiveness.

Deficiency/lacks of cross-correlation analysis are: the

disturbance/breakdown of hypothesis about the stationary character/nature of electroencephalogram, the low effectiveness of the time/temporary permission of the parameters of the current correlative functions and the complexity of the realization of the algorithms of the multidimensional operational cross-correlation analysis, since for obtaining the matrix/die of the coefficients of cross correlation it is necessary to ensure storage discrete coordinates of the corresponding time/temporary samples EEG.

This method turns out to be especially bulky and difficult to realize if necessary for perfecting multidimensional for frequency domain processes, which is bonded with the need of obtaining the multidimensional matrix/dies of the coefficients of cross correlation.

The disregard of properties EEG in frequency domain leads to the loss of that part of the information, which characterizes the extrapolating functions of brain. Statistical structure EEG it can be investigated with the aid of the methods of nonlinear autocorrelation analysis. The method in question turns out to be more adequate the physiological model of brain, since it considers time/temporary and frequency properties EEG and it possesses the higher degree of the time/temporary permission of the statistical parameters. At this method can, in particular, be estimated the degree of the nonlinear

distortions of the biopotentials between the sections of the working brain. In this case the model of the brain is presented in the form of the multidimensional, nonlinear, synchronous detector, which realizes demodulation of afferent information flow and time/temporary selection of the signals, correlated with the frequency parameters of the codes of dynamic stereotype. Separate neuron ensemble presents the nonlinear circuit, which converts statistic structure EEG, that enters its entrance.

The selective notations of biopotentials, recorded in the different sections of cranial integument, are examined in the form of the signals, observed in the output/yield of the multidimensional detector, which consists of the totality of neuron ensembles, it will be conditioned by the time/temporary dependence of their characteristics of nonlinearity.

The representation of the time/temporary dependence of the characteristics of the nonlinearity of neuron ensembles corresponds to the physiological phenomenon of the parabiotic reaction of the nerve tissues, consisting in nonlinear character/nature reaction to input signals. To the determined form/species of the characteristics of the nonlinearity of structural detectors at one level or the other of operator's mental stress will correspond statistic structure determined type EEG.

Thus, the task of the establishment of the cross correlation between time/temporary samples EEG of different removal/diversions, typical for cross-correlation perfecting, in the case of nonlinear autocorrelation analysis is reduced to the development/detection of the structural sections of brain, which are characterized by the determined degree of excitation.

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During the solution to the problem of the operational monitoring of reliability level of brain can be assigred the threshold values of the excited level of neuron ensembles in the removal/diversions being investigated for the different sections of the frequency spectrum EEG.

During the analysis of encephalogram was assumed its essential transiency, bonded with a change of the characteristics of the nonlinearity of neuron ensembles both in time/temporary and in frequency domain.

The algorithms of perfecting the selective realizations EEG in the electronic computer "M-20" provided for the execution of

surgeries of multichannel centering of EEG (12 canals) for the purpose of the liberation/excretion quasi-stationary component, the calculations of the coefficients of excess and asymmetry centered component for the operational checking of the hypothesis of the normal distribution of the filtered components, the calculation of the autocorrelation functions of centered EEG the calculation of the correlative multipole moments.

As the initial data were utilized EEG, recorded at installation "Alvar" on six removal/diversions from the frontal front/leading-temporal and temporal-postcranial symmetrical ranges of hemispheres. The typical scheme of removal/diversions is given in Fig. 1. About each removal/diversion are given indices which characterize the dispersion of biopotentials into the initial and final stages of experiment. Despite the fact that in the process of experiment is observed the redistribution of power EEG among separate removal/diversions, the total level of the dispersion of the centers of left and the right of the hemispheres of brain turns out to be different (above for the left hemisphere) into the initial and final stages of experiment. Tested solved the problem of the selection of the sequence of the commutations of the photic signal panels of console whose disconnection occurred according to the completely determined rule. On the basis of experiment was developed the algorithm of operations, by which in short time assured the

disconnection of all signal panels.

Notation EEG conducted at the initial moment of work on console and at the end of the experiment after 2 hours of the strained activity of tested. The final goal of statistical analysis was the determination of the relative parameters, characterizing a change in the nonlinear properties of the sections of brain against the background of long running.

As the basis of the subsequent statistical analysis was embedded the hypothesis about the fact that the acceptable reliability level the operation of brain during execution by the tested of typical logical task can be back in the form of the matrix/die of the relative parameters of the nonlinearity of the sections of brain on the different phases of its work. The investigation of the characteristics of nonlinearity conducted in 12 frequency canals for centered component EEG, obtained on the basis of the relationship/ratio of the form/species

$$\xi_i^0(t) = \xi(t) - S_{T_i}\xi(t), \qquad (1)$$

where $S_{T_i}\cdot$ - integral operator of the current.

$$S_{T_i}(\xi(t)) = \frac{1}{T_i}\int_{t-\frac{T_i}{2}}^{t+\frac{T_i}{2}} \xi(\tau)\,d\tau.$$

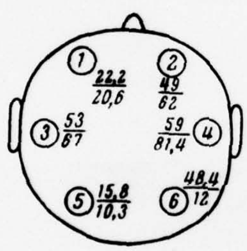

Fig. 1. The distribution of the centers of electric activity in brain according to the indicator of the dispersion of biopotentials in the symmetrical zones of left and the right of hemispheres 1, 2 - frontotemporal; 3, 4 - lower-temporal; 5, 6 - the temporoparietal removal/diversions, which correspond to the tertiary and secondary fields of brain, bonded with mental work; numerator is a beginning of experiment; denominator - the end of the experiment. As the indicator of effectiveness is examined the product $\sigma^2\tau$ of dispersion by an interval of correlation EEG of the corresponding removal/diversion.

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The parameters of smoothing T_i are selected on the basis of the requirement of stability (1) of the filtered components. The passband (the i-th) of the centering canal (in Hz) is determined by the expression

$$2\Delta f_i = 0.36\, i, \qquad (2)$$

where i - the number of canal.

The selection of the optimum canals of centering conducts on the criterion of the minimum of the dispersion of correlative function in the appropriate band of filtration (canal of centering).

Multichannel correlative analysis turns out to be adequate the unsteady model EEG, in the form the time function in question, which presents the mixture of almost periodic components with broadband fluctuating disturbance. In this case it is assumed that the mathematical model EEG can be represented in the form of unsteady random function with the generalized m-mi. by residue/remainders.

Investigation EEG conducted in the frequency band from 0.36 to 4.32 Hz. The correlative function of centered component $\xi_i^0(t)$ at the output/yield of neuron ensemble with the characteristic of nonlinearity y = g (x) is determined by the expression of the form/species

$$R_y^{(i)}(\tau) = \sum_{k=0}^{\infty} (1/k!)\, h_k^2 R_i^k(\tau), \quad (3)$$

where $R_i(\tau)$ - the autocorrelation function of centered EEG at the output/yield of neuron ensemble.

The characteristic of the nonlinearity of neuron ensemble can take the sufficiently form, being subordinated in this case to condition g (x) = 0 with x < 0. In the case of x > 0 Kaufman, Roberts

(1965) they showed that the coefficients h_k are determined by the expression

$$h_k(t) = \frac{\pi j}{2} \int_C f(\omega)\, \omega^k \exp\left(\frac{\sigma^2 \omega^2}{2}\right) d\omega. \tag{4}$$

where C is an outline of the integration.

Function f (ω) is obtained by means of Laplace transform from function g (x).

$$f(\omega) = \int_0^\infty g(x)\, e^{-\omega x}\, dx. \tag{5}$$

The interval of the correlation of process at the output/yield of neuron ensemble is determined from the formula

$$\tau_{\text{вых}} = \sum_{k=1}^{\infty} \frac{h_k^2}{k!} \int_0^{\tau_{\max}} |R_l(\tau)|^k\, d\tau. \tag{6}$$

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Since the series, which consist of the coefficients of the form/species

$$\psi_k = \frac{h_k^2}{k!} \text{ и } q_k = \int_0^{\tau_{max}} |R_i(\tau)|^k d\tau.$$

rapidly and absolutely converge, the right side of expression (6) can be replaced with larger value and obtained inequality in the form

$$\tau_{max} < \sum_{k=0}^{\infty} \psi_k \sum_{k=0}^{\infty} q_k. \qquad (7)$$

The accomplished in this case error is not very great and it is possible to approximately count:

$$\tau_{\text{вых}} \approx \sum_{k=0}^{\infty} \psi_k \sum_{k=0}^{\infty} q_k. \tag{7}$$

Coefficients q_k are called the absolute covariances of k order. We utilized the algorithms of the calculation q_k to the tenth order. Figure 2 gives plotted function $q_k = F$ (k). Dotted line plotted/applied the approximating curve, determined by the expression of the form/species

$$q^{*}_{(k)} = q_1 \left(\frac{q_3}{q_2}\right)^{k-1}. \tag{8}$$

In the case $q_3/q_2 < 1$ approximately let us present the sum of the series

$$\sum_{k=1}^{\infty} q^{*}_k \approx q_1 \left(\frac{q_2^2}{q_2 q_3 - q_3^2}\right). \tag{9}$$

Substituting expression (9) in (7), we have respectively

$$\tau^{\bullet}_{\text{вых}} \approx q_1\left(\frac{q_2^2}{q_2 q_3 - q_3^2}\right)\sum_{k=0}^{\infty}\psi_k. \quad (10)$$

The analysis of the results, obtained during calculation on EVM [computer] of the first ten covariances q_k EEG the calculations, made by formula (9), shows that the relative error does not exceed 3o/o.

When using relationship/ratio (10) considerably is decreased the volume of reckoning surgeries on computer, since for the realization of the corresponding algorithm is required to know the first three the absolute covariances.

In actuality for the examination of the nonlinear characteristics of the brain between separate removal/diversions it is possible to be restricted to the calculation of the relative indicators of the form/species

$$N_{ij} = \frac{\tau^{\bullet}_{II}}{\tau^{\bullet}_{I}}. \qquad (11)$$

Index I corresponds to the initial moment of work on console, II - the end of the experiment. Coefficients N_{ij} are calculated for all possible combinations of communication/connection between the neuron ensembles of the removal/diversions EEG being investigated. Is calculated the matrix/die of coefficients N_{ij} for the stationary components centered component EEG.

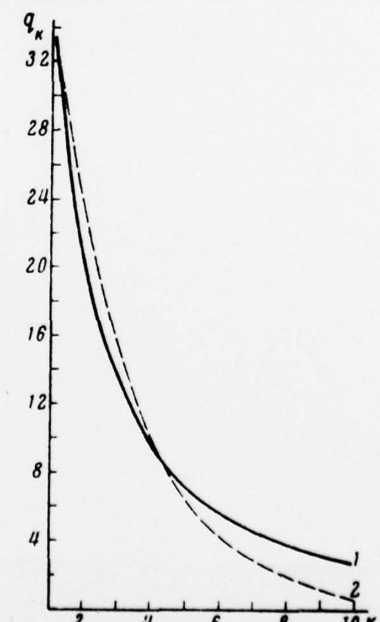

Fig.2

Fig. 2. The curve/graph of the absolute covariances: 1 - it is simulated on computer; 2. approximate.

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With consideration of the assumption about the fact that the function $\psi_k(t)$, and the expression

$$\frac{q_2^2(t)}{q_2(t)\,q_3(t)-q_3^2(t)}$$

slowly change in comparison with q_2 (t), expression (11) takes the form

$$N_{ij}=\frac{\dot{\tau}_{II}}{\dot{\tau}_{I}}\approx\frac{q_2^{(II)}}{q_2^{(I)}}. \tag{12}$$

Thus, for the qualitative examination of the nonlinear properties of brain it is possible to use expression (12) and to

perform the calculation of the absolute covariances of the second order. Is given below the table of the relative indicators of nonlinearity, calculated for the canal of centering with band $2\Delta_4$ = 4.32 Hz.

Characteristic is the sharply pronounced level of relative nonlinear distortions EEG between the various sections of brain, which confirms hypothesis about the applicability of the model of multidimensional detector.

However, if the data of the analysis of the level of the nonlinear distortions of biopotentials at the output/yield of one canal of centering make it possible to judge the statistical properties EEG in time domain, then for judging about the dependence of the characteristics of nonlinearity in the different sections of frequency spectrum of EEG it is necessary to perform the calculation of multidimensional conditional probability.

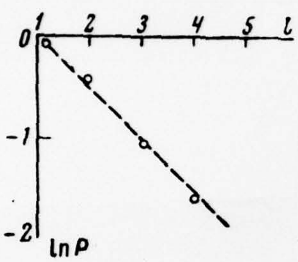

Fig 3.

TABLE

$q_2^{(I)}$ (сек)		0,0465	0,0143	0,0472	0,0332	0,0715	0,0405
$q_2^{(II)}$ (сек)	j \ i	1	2	3	4	5	6
0,0346	1	0,743*	2,4	0,73*	1,04	0,485	0,85
0,0364	2	0,79*	2,55	0,77	1,1	0,51	0,90
0,0672	3	1,44	4,7	1,42	2,02	0,94	1,66
0,0369	4	0,79*	2,58	0,78*	1,11	0,515	0,91
0,0449	5	0,97	3,14	0,95	1,35	0,628	1,11
0,0263	6	0,56	1,82	0,55	0,79*	0,37	0,645

Fig. 3. a change of the conditional probability $P(N_{ll}^{l})$ the relative indicators of the nonlinearity of brain depending on the number of canals l.

Table. Relative indicators of the nonlinearity of brain for component EEG in the band of analysis 4.34 Hz.

The note: by index j is designated the number of the removal/diversion, which corresponds to the final stage of

experiment; i - to the beginning of experiment. By turnstile are noted the results, corresponding with 10o/o accuracy to the identical levels of the relative nonlinear distortions of biopotentials. The level of nonlinear distortions N_{ij} in the case in question is equal to 0.7-0.8.

Ke: (1). s.

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Figure 3 on logarithmic scale gives the dependence of probability $P(N^l_{ij})$ on the number of canals l.

The data of Fig. 3 show that there is determined correlation between the levels of nonlinear distortions EEG in the different sections of the frequency spectrum. a change in the number of structural communication/connections with the identical level of nonlinearity changes on logarithmic scale linearly depending on the number of centering canals l. Here interesting is the experimentally reveal/detect/exposed fact of the linear character/nature of change in the logarithmic scale of communication/connection between the relative indicators of the nonlinearity of brain in the different sections of the frequency spectrum EEG.

The presence between the statistical parameters EEG of correlation in frequency domain conditions the high stability of the dynamic functioning of those local structures of brain, synchronous excitation of which realizes the determined algorithm of operation (dynamic stereotype).

The properties of the operationally computed functions lnP can be used for the checking of the level of operator's mental stress in the system of "person and automat" during the execution of surgeries, bonded with the determined stereotypical nature of the operations.

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